DATA PROCESSING DIGEST

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General Information

"Decision making in the age of automation"

Melvin L. Hurni, General Electric Company.

HARVARD BUSINESS REVIEW, September-October, 1955; pages 49-58.

Automation imposes the necessity of completely new concepts of management

The new era of automation has crept up on us, and we have become used to new methods gradually, without being aware of the need for revising traditional approaches. Even "smaller" businesses are affected, and those which have grown through dispersion of operations and of markets. The business manager has more people reporting to him, and less chance to see at first hand the business as a whole.

"Special means are therefore required to communicate common understanding within the framework of a variety of somewhat specialized environments. This problem is *not* solved by providing more volume of data for all concerned, or faster accumulation and transmittal of data, or wider distribution of previously existing data, or through holding more conferences....There *is* required, by contrast, the orderly study of the system in its entirety to discover what specific information is needed at a particular position in view of the decision to be made there."

One of the trends which is significant is the "increasing tendency toward introspection with respect to the business processes themselves ....It has led to insights that have radically revised methods and procedures and resulted in striking benefits." In fact, "we have entered an era in which competition for concepts about the basic nature and structure of a business is coming to be as real as competition in the market and in the research laboratory." However, new structures and systems are usually the result of long study and are designed for specific situations, and copying such a system in another situation does not guarantee similar results. Thus, competition can not be met by the copy method, but only by foreseeing the trend, and preparing for it now. It is important to see, also, that automation is not confined to the automatic manufacturing techniques, but has its roots in "the logic of an over-all system of operation," which includes marketing and engineering design as well.

One of the dangers of automation is its inherent inflexibility. Once a system is set up, it is difficult to change, especially for rapid and slight variations in product, or market. "Automation, therefore, imposes on management the need for not only a longer and more rigorous planning period prior to installation but also a longer period of risk without the benefit of marginal correction. The evaluation of the opportunities and the risks thus demands a higher order of rationality than was previously required." One answer to this quality of inflexibility is the greater standardization of products both in the design and the fabrication processes as well as a variety of designs to meet customer needs, and the use of a single product or production technique in a variety of situations.

"From a technical standpoint, the basis for developing organized and more systematic means for decision making is at hand. A sufficient number of individual methods are available to make a good start. The now somewhat familiar terms of *operations research* and *statistical decision making* refer to these methods....It is possible through systematic study to describe rather large classes of business phenomena more precisely than was traditionally thought possible....in mathematical terms. The crisper the description, the less reliance need be placed on feel or experience, and the easier it becomes to evaluate changes or to communicate about these phenomena."

"A situation requiring decision can be subjected to rational and systematic examination. It is possible in many circumstances to formulate definite hypotheses or models of a real situation and evaluate them for their relative effectiveness, risk, and cost before anything is put in place physically."

A case history is given of a company which worked out a systematic description of the development of a new product, then found marketing information, research and development needs, and probable production requirements through scientific and mathematical methods, to forecast the results of producing the new item.

Steps to the new era are listed:

1. Establish research in market structure, the contribution of specific product lines to volume and profit, the expected demands for various products and the expected variation in such demands, and the degree of evenness in receipt of orders.

2. Apply this knowledge to the clarification of the assumptions underlying the conduct of the business.

3. Use this research to describe the plans and policies on which the operations of the business are based.

4. Apply this information to the practical problems of decision making.

5. Direct research to devising measurements that make manage-

ment aware of significant changes in the structure of the market or in the environment in which the business exists.

6. Make studies of the relative merits of different plans and policies in the light of company objectives.

"Electronic data processing"

Edward L. Wallace, Harvard University

CONFERENCE PROCEEDINGS (N.O.M.A.), published by OFFICE EXECUTIVE, July 1955; pages 41-49.

Careful study is needed in selecting equipment

Some problems in selecting electronic equipment for various types of data processing applications are discussed, with examples drawn from organizations already using such equipment.

Magnetic tape is suggested as a medium for external storage which meets two needs: speeds comparable to those of internal processing, and storage in condensed form for easier handling. Punched cards, paper tape, mark sensed materials and other forms of external storage answer needs other than computer compatibility, and are useful for maintaining visual files, as customer bills, for mailing purposes, etc.

Internal storage considerations are access speed, reliability, cost, versatility, and ability to perform additional work in future.

Special purpose versus general purpose equipment is also considered.

"Automatic digital computers in industrial research"

R. F. Clippinger, B. Dimsdale, and J. H. Levin.

*JOURNAL of the Society for Industrial and Applied Mathematics, Part VI, June 1955; pages 80-89. **

Only the smallest business will be unaffected by electronic record-keeping

In the final article of the series the authors look forward to the future potential uses of electronic computers in both technical and business applications. They see the need for increasing mathematical research, for larger storage systems in computer equipment, for integrating the computer into the organization, for greater reliability of equipment, for studies in programming and problem preparation, for improvement in computer performance, for conversion facilities between analog and digital information, for cost reduction, for compactness of equipment, for applications in scientific fields, and for more extensive business applications.

In this last field, "we can expect the most dramatic results in the near future....a revolution in record keeping by making systematic use of large

scale magnetic tape memories with capacities up to two billion decimal digits which can be quickly scanned and modified." This will result in "drastic reductions in paper work....reduction in storage space, reduction in record keeping overhead....better control of inventory and therefore reduced inventory....more even flow of materials through our productive system, and greater stability in labor requirements. It is our belief that production in many areas will be increased by something like 10% for this reason alone."

Executives will know the status of their business as of now, and will be able to make more valuable decisions. "These are some of the benefits we foresee resulting from the simple matter of keeping records more accurately and rapidly....these benefits are so important that no moderately large business will be able to resist the trend, and...the conversion to this type of record keeping will be nearly complete. There will be no business or industry with more than 500 employees which is without the services of an automatic digital computer."

The article is summed up in the quotation from a speech by Dr. Vannevar Bush: "'There is no reason why man should not relegate to the machine all those parts of his processes of cerebration which are repetitive in nature, or subject to exact formulation, thus freeing the mind for those processes which the human brain alone can encompass...'"

**Parts I through IV were reviewed in DPD, June 1955; page 3. Part V was reviewed in DPD, September 1955; page 6.*

"Data processing systems: how they function"

Jerre D. Noe, Stanford Research Institute, Menlo Park, Calif.

CONTROL ENGINEERING, October 1955; pages 70-77.

Data processing functions are same in manual or electronic methods

The first article in a series, this describes the basic principles in automatic data processing systems by comparing the manual and automatic methods of performing three types of data-handling problems.

"Digital computers are essentially means for mechanizing repetitive operations....such as are frequently encountered in scientific calculations, in business data-handling problems, and in the control of dynamic processes ....Units in these automatic data handling systems are capable of storage, calculation, control, and communications, and the general interrelation of these elements is basically the same, regardless of application. ((See Figure 1.)) The functions named exist whether the system is manual, in which case the work is done with desk calculators, or mechanized, so that it can be entered into an automatic computer."

Diagrams for examples of each of the three types of problems compare the manual and the automatic methods, and are accompanied by a description of the procedure for each.

"Principles, not machines, lead to systems improvement"

OFFICE MANAGEMENT, September 1955; pages 28, 29, 42, 92.

Introduction to integrated data processing

This is an introduction to "paperwork simplification" and the principles of integrated data processing based on the use of punched paper tape as the "common language" used by all of the office machines in any specific system. The familiar principles of IDP are restated: 1) Original data is recorded at the point of origin in mechanical form; 2) once this data is in mechanical form it is processed exclusively in mechanical form; 3) all processing is integrated so that the original data in mechanical form serve all subsequent operations.

The article is of value to those persons not yet familiar with principles, processes, and potentials of integrated data processing methods.

"A review of automatic technology"

*MONTHLY LABOR REVIEW, February and June 1955 **

"The meaning, outlook, and implications of automation," *by Edgar Weinberg, Bureau of Labor Statistics*

Traditional business and labor practices will be gradually re-structured by automation

Automation is considered in each of four categories: automatic machinery, integrated materials handling and processing equipment, automatic control systems, and electronic computers and data processing machines.

The conclusions are that while there is a "likelihood of fairly steady growth" in technological improvements, there will be no "economywide revolution." "In brief, the elusive and sensitive human factor may prove one of the important brakes on the rapid diffusion of the new technology.... With broader understanding, automatic technology and greater productivity become the basis for enriching life in a free society."

"The effect of automation on industrial relations," *by George B. Baldwin and George P. Shultz, M.I.T., Cambridge, Mass.*

Some general areas that seem likely to be affected by automation are working conditions, incentive systems, managerial responsibility, training (or retraining), wage structure, union jurisdictions, internal structure of unions, seniority units, and employment. It is probable that "as a standard for continued employment, 'ability to learn' would gradually replace 'ability to do' the job." The fact that any change to more automatic methods takes much time and demands a great deal of planning will aid in solving any labor or employment problems brought about by the proposed change.

**Published by U.S. Dept. of Labor, Bureau of Labor Statistics. Reprint No. 2166, price, 10¢. Order from Supt. of Documents, Washington 25, D. C.*

"Automation: some human problems"

W. E. Vannah, Editor of CONTROL ENGINEERING

PERSONNEL (AMA), September 1955; pages 100-106.

New concepts of labor brought on by automation

Automation will bring some changes in labor-management relationships. For example: "Automation may make drastic revisions in seniority necessary....perhaps seniority should become company-wide...."

"Changes will be needed in incentive systems also....The machine is set to produce the required number or volume; therefore, the worker's responsibility shifts to trouble-free operation."

"Automation will also bring about a steady increase in high-grade technicians and...low-level engineers....We shall probably see...collective bargaining for semi-professional engineering grades."

"Electronics--possibilities and limitations"

Virgil F. Blank, Haskins & Sells.

SYSTEMS AND PROCEDURES QUARTERLY, August 1955; pages 8-15.

Systems people are challenged to utilize new equipment

Some of the factors to be considered in choosing and making use of the equipment are input and output needs, costs, reassignment of personnel, and extent of system changes required. "While there is every reason to believe that there will be continued development and evolution of electronic machines and ideas, it would appear that the machines are presently developed beyond our current thinking or experience with regard to making maximum use of their potentials. This, then, is the real challenge to systems and procedures personnel."

"Economic consequences of automation"

Walter S. Buckingham, Jr. (Georgia Institute of Technology) and Sherman F. Dallas (Indiana State Teachers College).

JOURNAL OF INDUSTRIAL ENGINEERING, July-August 1955; pages 11-13, 26.

The effects of automation upon our traditional system of competitive business are considered. Industries are divided into three classifications according to the extent to which automation can be applied. The effect of automation on labor is discussed.

"For more sales; integrated data processing"

CHEMICAL WEEK, September 3, 1955; pages 44-45.

The chemical industry is beginning to use IDP methods. An example is given, of the way in which General Chemical processes sales orders by punched tape and punched cards.

"The future in automation"

Albert Pleydell, Management Consultant

OFFICE EXECUTIVE, September 1955; pages 13-15.

A brief rundown is given of the present status of equipment and methods in electronic data processing.

"What automation means to America"

FACTORY MANAGEMENT, September 1955; pages 84-90.

Automation is needed throughout the entire economy in order for us to meet the needs of the growing population and the rising living standards.

"Office Automation: Integrated and Electronic Data Processing"

R. Hunt Brown. New Book--published by Automation Consultants, Inc. September 1955.

Descriptions of equipment and up-dating service

"...This book is intended principally for the top level executive who is not too familiar with the matter and would like to know more about it."

The aspect of the book which probably will be of major interest to most readers is the 180-page Hardware Section which describes the latest equipment of the major manufacturers. In most cases, summaries of the main equipment characteristics are presented, along with prices, pictures of the equipment, and addresses of the manufacturers. The following types of equipment are discussed: Electrical communication facilities, common language machines, native language machines, electronic computers used with punched card machines, general description of electronic computers (large, medium, small, and special purpose), memory systems used with computers, output printers. One hundred and five different pieces of equipment are covered.

The other sections of the book contain less detail; rather, they are brief discussions of the many factors involved in office automation. The

Commercial Section of 24 pages discusses briefly such subjects as: What is automation? Why should you further examine office automation? and What has been done about automation? Other sections totalling 44 pages include electronic accounting, social consequences of automation, and a scientific section. The final section of 33 pages is concerned with future developments, and briefly discusses several proposed types of installations, for banks, stock exchange, insurance, department store, and other applications.

An up-dating service is offered which should keep the Hardware Section current, as new types of equipment are announced or changes are made to existing equipment. It is possible also, that this up-dating service will be of value in modifying and improving these other sections of the book. In some of the sections, the author has not yet had a chance to treat the subjects adequately, probably because of the amount of effort that was spent on the Hardware section. More detailed treatment of case histories would be desirable, for instance, showing the difficulties encountered and the solutions which were developed. Some tutorial material on the problems of programming and systems design would be of great interest. The up-dating service gives the author an opportunity to expand his initial efforts.

The 283 pages are bound in a loose leaf binder to facilitate keeping it up to date. Price: $12.50. Annual charge for up-dating service, $25.00.

Equipment

"What management should know about facsimile"

MANAGEMENT METHODS, September 1955; pages 31-33.

Facsimile is a "building block" in office automation

In a question and answer article, Casper M. Bower (Gen. Mgr., Facsimile Equipment Div., Air Associates, Inc., N. J.) gives a few facts about facsimile as a "building block" in office automation. It offers rapid transmission of an exact copy of a document between points only a few feet apart, or many miles apart. A full 8½" by 11" page takes 3¼ minutes to transmit on the 360 rpm machine. Examples of the use of a facsimile machine are in-plant transmission of engineering changes to the production department, contact between the editorial department of a publication and its printing plant, cross country communication between two plants of the same company. The TVA uses facsimile between Chattanooga and Wilson Dam for speedy flow of data necessary for the control of electric power, floods, and irrigation. Estimated transmission time has been about ¼ that of teletyping. Mr. Bower believes "the only 'experimental' factor is one of finding new applications to which [facsimile] can be applied."

"Automatic private-line teletypewriter switching system"

BELL LABORATORIES RECORD, September 1955, pages 321-326.

Bell-designed teletypewriter

The 8101 Bell teletypewriter system stores and retransmits messages originating in any part of the system, automatically transmits messages from the various stations as they become available, and delivers them only to the station or stations addressed. "Urgent messages receive priority treatment. Messages addressed incorrectly, or to a machine temporarily out of service, are automatically intercepted and held for further handling. When several stations normally receive the same messages, they may all be reached by a single group code preceding a message. Further, when desired, an automatic address unit will properly address messages to selected stations or groups of stations simply by the operator pushing a button."

UNIVAC II

DIGITAL COMPUTER NEWSLETTER (Journal of Association for Computing Machinery, July 1955), pages 218-220.

Operating and programming facts on Univac II

The new Univac II magnetic core electronic computer doubles the speed and accuracy of the Univac I. It has a 2000-word magnetic core memory; input-output tape read and write speed is now 20,000 characters per second; it contains a maximum of 10,000 words of high speed internal memory; information capacity of a reel of tape is approximately 3,000,000 characters. A table of comparison between the two models is given:

Operating Area	UNIVAC I	UNIVAC II
1. CENTRAL COMPUTER		
(1) Memory	1,000 words of 12 characters each (alpha numeric)—12,000 character capacity. Memory delay—line storage system.	2,000 words of 12 characters each (alpha numeric)—24,000 character capacity. Additional 2,000 word increments of memory up to 10,000 words, (120,000 characters) may be added.
		Magnetic core storage system.
(2) Instructions		All instructions now in UNIVAC I, plus:
	Extract order—transfers predetermined pattern of digits from memory to arithmetic unit.	Field selector—all instructions referring to memory operate under control of extract pattern.
	One, two and ten word transfers.	One to 10 word transfer order.
(3) Time	Transfer to registers, 425 micro-seconds. Addition 525 microseconds.	Transfers to registers, 120 micro-seconds. Addition, 200 microseconds.
(4) Control	Four-stage cycle of operation.	Three stage cycle of operation.
2. TAPE UNITS (Metal)		
(1) Capacity	1,440,000 digits per 1,500 foot reel.	3,000,000 digits per 1,500 foot reel.
(2) Number of tape control units (Uniservos)	10	10 (more under consideration)
(3) Length of tape	1,500 feet	1,500 feet
(4) Density	128 characters per inch	200 characters per inch
(5) Speed	100 inches of tape read in and out per second or 12,800 characters per second.	100 inches of tape per second or 20,000 characters per second.
(6) Start and Stop time for tape feeding.	45 Milliseconds.	15 Milleseconds.
(7) Space between each block of 60 words.	2.4 inches	1 inch
(8) Time to read one block of 60 words.	100-104 milliseconds (200 instructions)	45-50 milliseconds (300 instructions)
(9) Blocks of 60 words per 1,500 foot reel of tape.	2,000	4,000
(10) Reading time	3-1/2 minutes (2,000 blocks)	3-1/2 minutes (4,000 blocks)

Applications

"How one company utilizes a medium-sized electronic digital computer"

MANAGEMENT METHODS, September 1955; pages 44, 45.

Insurance company plans for full time use of computing system

Allstate Insurance Company, Skokie, Ill., has entered the first phase of a three-phase program of utilizing its Datatron (ElectroData Corp.) computing system. The equipment cost about $250,000, and includes the main computer, three magnetic tape drives, control console, high-speed optical tape reader, two electric typewriters with tape reader and punch, IBM converter unit, motor generator set, and power control units.

During the first phase the system will be used for a few hours each day to prepare reports such as premiums, written statements, office, sales, and claim expense statements, quarterly personnel analysis, company car fleet costs, and several quarterly experience reports. Even though it is now used a fraction of its available machine time, the company estimates it will pay for itself in two years. The first application was the production of a quarterly report to the Underwriting Department. This originally took 1800 man-hours by manual methods. Later, it took 100 man-hours by mechanized punch-card methods. The electronic computer has brought the time factor down to 12 hours. Programming time for the routine which will be used repeatedly, was three months. The second phase of use will be developing internal summaries. The third phase is the extension of the computer's use to all of the branch offices. Studies are now being made for use of the computer on a second shift. The computer is handled by a methods research staff of six men.

"Now even small bookstores can mechanize their addressing"

PUBLISHER'S WEEKLY, September 10, 1955; pages 980-982.

Typing step eliminated by simple method

Sometimes an apparently small, unimportant improvement in data processing can bring large rewards. For this reason DPD mentions this unusual use of McBee Keysort cards combined with the low-cost Master Addresser spirit addressing machine. Kroch's & Brentano's (bookdealers) maintain interest files on Keysort cards. The name and address are typed on the card with a spirit duplicator master imprinting the reverse side. For a mass mailing to a portion of the files, the cards are removed in the typical Keysort fashion, and immediately run through the Master Addresser machine to address the envelopes, eliminating further hand typing.

"In production"

BUSINESS WEEK, September 10, 1955; pages 120, 124.

Braniff International Airways, Inc. will have an electronic reservation system, designed by Teleregister, by late 1956. It will serve the entire airline, in contrast to other airlines' machines which serve only separate cities.

"An English electronic office"

OFFICE EQUIPMENT EXPORTER (The OFFICE Magazine) 1954 Edition; pages 82, 85.

Custom-built computer performs many office jobs

J. Lyons & Co., Ltd., bakers and caterers of Cadby Hall, London, have installed an all-purpose electronic high speed calculator for ledger keeping, inventory control, invoicing, cost accounting, and working out the involved payroll calculations for its 33,000 employees. LEO (Lyons Electric Office) was designed to satisfy Lyons' requirements, and was based largely on the experimental Cambridge University Machine. Inputs for the payroll are partly punched card (for constants and information carried forth from the previous pay period) and partly punched paper tape (for each week's information). Calculations per employee take about one second. Three main processes are being carried out at the same time: printing of pay slips for employee A, calculations for employee B, and drawing information from punched cards and tapes for employee C.

"An IDP order-invoice system"

Walter T. Gibson, Rockwell Mfg. Co., Pittsburgh, Pa.

THE OFFICE, September 1955; pages 78-81.

Description is given of Rockwell's order processing system which uses a programmed punched paper tape prepared from a file of punched cards, and transmitted to the designated warehouse by teletype. (See DPD October 1955, page 14.)

"Utility promotes computer to a top job"

BUSINESS WEEK, September 10, 1955; pages 112, 113, 116, 118.

Within the next year or so, Southern Co. (which provides power in Mississippi, Alabama, Georgia and Florida) and Ohio Edison Co. will be using electronic computers, to process data, make decisions, and then tell each generator what to do.

Management Decision-making Techniques

"An analysis of a railroad classification yard"

Roger R. Crane and Frank B. Brown, Westinghouse Air Brake Company, Pittsburgh, Pa., and Robert O. Blanchard, IBM, New York.

JOURNAL of Operations Research Society, August 1955; pages 262-271.

Simulation methods point to savings in freight yard operations

The problem in a classification yard is to inspect each freight car and classify it as to outgoing train. The authors simulated the actual yard on paper, choosing arrivals and processing times at random. Based on these studies they were able to show possible improvements to the extent of $160,000 per year by suggesting 1) performing inspection and classification at the same time and 2) by better utilization of switch engines--using them for odd jobs when no cars are waiting to be processed.

"Production and inventory control in a chemical process"

Russell L. Ackoff, Case Institute of Technology, Cleveland, Ohio.

JOURNAL of Operations Research Society, August 1955; pages 319-338.

Algebraic and statistical techniques lead to cost reductions

An analytic study of the costs associated with a chemical process indicated that 1) recycling losses were such that net income was greater when no recycling was used; 2) that reducing the interval between sales forecasts would allow increased income by reducing inventory cushions; 3) that production could be controlled to reduce inventory and still stabilize employment; and 4) that control techniques could be worked out to insure that the scheduling method continued to be valid, and to detect changes in the number of crews required to meet the demand.

((It should be recognized that the results mentioned above apply only in the cases studied. The important point is the techniques used. In one case a situation containing randomly varying factors is simulated by a "paper-model" in which the factors are selected at random. Since the simulation proceeds much faster than the actual situation, many techniques can be tried in a short time. In the other case, a direct algebraic formula is established for costs (by appropriate study of past history) and the effects of demand, employment, etc., are evaluated by use of the formula.))

Control

"Take a card for machine tool control"

D. B. Schneider, General Electric Co., Waynesboro, Va.

AUTOMATION, October 1955; pages 36-39.

Machine tools controlled by punched cards

"An automatic control which uses punched business machine cards to control machine tools has been developed by the General Electric Co.'s Specialty Control Department. Called Numerical Positioning Control, the new system is adaptable for use on a wide variety of machine tools including the riveting machines, placement machines, milling, boring and drilling machines, punch presses, lathes and shears. Its immediate application is on a Wiedemann 80-ton turret type press used to punch holes in panels for control boards."

Remington Rand cards are used, with decimal position information for at least one machining operation on each card. The cards also have space for other information, such as operator's instructions. "All positions are measured from a zero reference point rather than from a previous position to prevent any possibility of cumulative position error."

"Electric transducers for automatic weighing"

R. E. Bell, Toledo Scale Co., Toledo, Ohio.

ELECTRICAL ENGINEERING, October 1955; pages 926-928.

"Electric transducers are designed for use with mechanical scales to obtain automatic weighing control. The advantages and disadvantages of the various types of transducers are given to assist the engineer in making the proper design for any special weighing system."

"Machine tool electronics for tomorrow"

STEEL, September 5, 1955; pages 84, 85.

A brief look at electronic devices and their potential use in machine tool operation.

Comment

Review of Remington Rand Automatic Programming Techniques (with some explanatory comments)

Part II (Part I appeared in the September issue.)

Programming time is reduced by using computer to carry out part of the process

An important aspect of compiling methods is the technique of relative coding. All sub-routines are coded as if they were stored in the machine's memory starting at some arbitrary location (say, cell 000). The coder then does not have to be concerned with the final actual memory locations, which makes coding somewhat less tedious.

The Sperry Rand A-2 (mathematical)[2] compiler utilizes the Univac internal memory in a very specific and predetermined format, during the actual running of the problem. The memory is broken up into blocks--a block for working storage a block for storing input data, a block for storing output data, a block for the actual program, etc. The sub-routines can then be written relative to the starting location of these blocks.

Some compiling systems, such as the Underwood system, allow the programmer to indicate whether the addresses in a sub-routine are relative or absolute (absolute referring to a specific memory location in the machine). In such a case, two machine instructions are needed for each sub-routine program step: the first instruction indicates the desired operation and the operands, while the second ("qualifier") instruction indicates whether the addresses of the operands are relative or absolute. Relative addresses may be broken down into two types: those applying within the sub-routine itself, and those referring to addresses in other sub-routines. After the compiling operation has been completed on the sub-routines, of course, the "qualifier" instructions have been removed and only the actual instructions remain.

In the compiling operation, the Univac A-2 compiler goes through four major steps. In the first, a translation step, each pseudo-code is checked against a catalog and is expanded by adding some detailed information, so that it is more easily recognized by the compiler routine. The next step is a sequential inspection of all of the expanded pseudo-codes in the program; if any generator operations are found, the desired routine is generated and stored on a tape. Also, the desired sub-routines are found and stored on this same tape. The third step is another sequential sweep through the expanded pseudo-code, looking for certain types of operations, and modifying them according to rules. The fourth step is the main compiling step, in which the desired sub-routines are brought in, in the desired sequence, and linked together to form the final program.

Another Sperry-Rand compiler is the BIOR,[3] developed for use on the Univac, for handling business input-output routines. In this case, the sub-routines handle such operations as item advance(e.g. reading in the next master record, to be updated), item counting (keeping track of the number of items handled), detecting sentinels, switching tape units, handling units, handling partial blocks of data, etc. Sentinels are used to signal partial blocks of data, end of a tape, and end of

a file. It is this type of operation that can be most readily standardized, from business to business, and the place where compilers will first be seen in business.

It should be remembered that these compilers do not do any computing themselves--they just assemble the detailed program which will do the computing.

Other terms which are beginning to appear in the literature, such as autocheckers, do not properly belong in a discussion of automatic programming. However, these other techniques do fall into the class of *service routines*--services which the computer can perform automatically for the programmer--of which automatic programming is one member. *Automonitor* routines, for instance, will cause the computer to print out the details of what it has done at each step of the program being tested--a type of feedback to the programmer.

These automatic programming techniques are almost sure to influence the development of computers.[1] Instructions will be added to the computers to facilitate such coding--perhaps for the handling of "qualifier" instructions, for example. Also, instructions which are now used in computers just for the convenience of a programmer may be omitted, since the computer will be doing the detailed coding.

As one expert in the field has put it, "There is much to be learned [in automatic programming]. So far, as each group has completed an interpreter or compiler, they have discovered in using it 'what they really wanted to do.' Each executive [automatic programming] routine has lead to the writing of specifications for a better routine....Future compiling routines must be independent of the type of program to be produced. Just as there are now general-purpose computers, there will have to be general-purpose compilers."[1] This will be a step in the direction of automatic preparation of programs for inventory, payroll, etc., to meet each company's specific needs.

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1. "Automatic Coding for Digital Computers," by Dr. Grace Murray Hopper (Sperry Rand), a talk presented at The High Speed Computer Conference, Louisiana State University, February 16, 1955. (Reprints available from Sperry Rand.)

2. *The A-2 Compiler Instruction Manual*, Remington Rand, Inc., 1955

3. *LIOR Compiling System*, Remington Rand, Inc., 1955.

Training, Seminars, Meetings

"Problems of electronic applications in the office," AMA Seminar; two meetings--Nov. 28-30, 1955; Jan. 9-11, 1956. American Management Association, New York.

Operations Research Symposium, University of Pennsylvania, Philadelphia, Dec. 14, 1955. For information write: R. V. D. Campbell, O.R. Symposium Registration, Burroughs Research Center, Paoli, Penna.

Engineering and Management Course, University of California at Los Angeles; Jan. 23 through Feb. 2, 1956. Includes five classes in data processing and related subjects among others. For further information write: Edward P. Coleman, Coordinator, Engineering and Management Course, College of Engineering, University of California, Los Angeles 24, Calif.

Western Computer Conference (IRE-AIEE-ACM), Feb. 8-10, 1956; San Francisco. For further information write Dr. Oliver Whitby, Stanford Research Institute, Stanford, Calif.

ORSA-TIMS Meeting (tentative), March 30, 31; University of California at Los Angeles.

Southern California Business Show (N.A.C.A.) April 24-27; Ambassador Hotel, Los Angeles. For further information write: R. E. McRann, General Chairman, So. Calif. Business Show, 731 South Spring St., Los Angeles 14, Calif.

OMISSIONS FROM THE OCTOBER ISSUE

Among the periodicals regularly reviewed by DATA PROCESSING DIGEST, is INSTRUMENTS AND AUTOMATION, inadvertently omitted from the Resource list on page 20 of the October issue.

The October issue of DPD listed the article "Automation in the United Kingdom," JOURNAL, Institution of Production Engineers, June 1955; pages 331-333. The address for this publication was omitted from the list of References. It is: 10 Chesterfield Street, London W.1, England.

References

American Management Association
1515 Broadway
Times Square
New York, New York

Automation
Penton Building
Cleveland, Ohio

Bell Laboratories Record
195 Broadway
New York 7, New York

Business Week
330 West 42nd Street
New York 36, New York

Chemical Week
330 West 42nd Street
New York 36, New York

Control Engineering
330 West 42nd Street
New York 36, New York

Electrical Engineering
500 Fifth Avenue, Suites 7 & 8
New York 36, New York

Factory Management
330 West 42nd Street
New York 36, New York

Harvard Business Review
Soldiers Field Station
Boston 63, Mass.

Journal of Association for Computing Machinery
2 East 63rd Street
New York 21, New York

Journal of Industrial Engineering
225 North Avenue, N. W.
Atlanta, Georgia

Journal of the Operations Research Society of America
7100 Connecticut Avenue
Chevy Chase 15, Maryland

Journal of Society for Industrial and Applied Mathematics
Box 7541
Philadelphia, Pa.

Management Methods
141 East 44th Street
New York 17, New York

The Office
232 Madison Avenue
New York 16, New York

Office Executive
132 West Chelten Avenue
Philadelphia 44, Pa.

Office Management
212 Fifth Avenue
New York 10, New York

Publishers' Weekly
1309 Noble Street
Philadelphia 23, Pa.

Steel
Penton Building
Cleveland, Ohio

Systems and Procedures Quarterly
Box 281, Wall Street Station
New York, New York

See DPD September, 1955, for list of more than sixty periodicals regularly reviewed for significant information in the data processing and related fields.

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